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Assessment of contemporary erosion/sedimentation trend within a small cultivated catchment in the Republic of Tatarstan (European Russia)

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Abstract

© 2018 Russian Academy of Sciences. An analysis of sedimentation at first-order-valley bottoms allows the gathering of a sufficiently reliable quantitative evaluation of soil losses from a catchment area for two time intervals (1963-1986 and 1987-2015) and its temporal variability. The catchment studied (Temeva Rechka, 1.13 km2) is located in the River Myósha basin, the northwestern part of the Republic of Tatarstan, Russia. Combination of methods and approaches was used for estimation of sediment redistribution for the both time intervals, including detail geodetic survey of main morphological units of the catchment dry valley, large scale geomorphological mapping, caesium-137 technique for sediment dating in typical locations of the valley bottom, calculation of soil losses using modified version of USLE and State Hydrological Institute (Russia) models. In addition, available information about dynamics of some climate characteristics for the period 1950-2015 was collected from regional weather stations. LandSat images were applied for evaluation of possible land use changes. Crop management coefficients were calculated separately for the rainfall and snow-melt periods using available data about crop-rotation dynamics for the last 55 years. A significant decrease of average annual soil losses from the cultivated part of the Temeva Rechka catchment was found for the period 1987-2015 compared to the period 1963 - 1986. Such conclusion was mainly based on different sedimentation rates in the valley bottom: for the period of 1963-1986 the average sedimentation rates were 0.92 - 1.81 cm per year, while for the period of 1987-2015 these rates were only 0.17 - 0.50 cm per year. The main reason for this significant decrease was the reduction of surface runoff caused by climate warming in the region. The warming led to a reduction of soils freezing depth before the snow-melt period, and to a decline in frequency of extreme (rainstorm) precipitation (40-50 mm per a rainstorm). The influence of agricultural activity on the erosion and sedimentation rates changeability was insignificant, although some regional variation of crop rotation including a increase in proportion of perennial grasses obviously caused a decline in soil losses during warm period of year. The same trend of erosion/sedimentation rates due to mostly climate changes was identified in some regions of the European Russia's southern half.

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Keywords

Caesium-137, Catchment, Climate change, Cultivated, Dry valley, Erosion, Forest-steppe, Land, Russian Plain, Sediment, Snowmelt runoff, Soil freezing

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